REMARKS

The Examiner rejected claims 1-3, 6, 15-18, 21 and 11 under 35 U.S.C. § 103(a) as being unpatentable over U.S. Patent No. 6,125,167 to Morgan. The Examiner also rejected claims 4, 5, 19 and 20 under 35 U.S.C. § 103(a) as being unpatentable over Morgan in view of U.S. Patent No. 6,188,747 to Geus. The Examiner also rejected claims 7-12 as being unpatentable over Morgan in view of U.S. Patent NO. 4,965,726 Heuscher. It is respectfully asserted that the present invention is patentable over the Morgan, Geus and Heuscher references.

The present invention is directed to the coverage area associated with current volume CT scanners. This causes lengthy scan times, which adversely affect the comfort of the subject being scanned. The present invention overcomes this drawback by proposing an x-ray anode providing increased scan coverage.

To accomplish this objective the present invention proposes an x-ray tube anode having two target faces 24, 26 oriented back-to-back with separate and opposing cathodes 40. The cathodes 40 are mounted at either end of the vacuum tube and run either simultaneously with or independent of each other based on the CT application.

The back-to-back arrangement of the targets 24, 26 allows each anode to produce an x-ray beam of substantial width and still be spaced at an axial separation consistent with obtaining two interleaved helical scans without cone beam artifacts, and still maintain high voltage stability. The separate

and opposing cathodes 40 can also be positioned to limit the amount of heat radiated from the target to each cathode; in Morgan the cathodes are located with hot x-ray targets on each side and will be challenged to operate coolly enough. The combination of back-to-back targets and individual cathodes provides a true double helical scan, with an artifact-free image upon reconstruction of the scan.

Because the anode arrangement of the present invention creates double the heat to provide the same number of x-ray photons in a given scan time, a radiation heat sink 36 is positioned between heat storage members 32, 34. The heat sink 36 provides a path to dissipate this excess heat at allowable target temperatures. This important feature is not taught in the Morgan reference.

It is necessary that the distance between a cathode and any other part of the x-ray tube should be large enough to avoid arcing between components. If the distance is too small, high voltage stability is compromised.

The Morgan reference is directed to the problem of excess heat during long exposure times associated with volume CT scans. The Morgan reference proposes an x-ray tube assembly that generates a quick volume scan thereby decreasing the amount of thermal energy absorbed by the anodes. Unfortunately, without the additional heat rejection mechanism, the approach taught by Morgan is unworkable for volume scanning. To provide the same image quality (contrast-noise ratio in the image) as a conventional scan, the beam current to each target disk must be equal to that in a conventional

scanner. The multiple-disk approach of Morgan does not provide the hoped-for advantage of reduced target temperature unless the targets can provide x-rays to the same imaged anatomy – which would require them to be within a few mm of each other in the axial direction.

To accomplish this objective the The Morgan reference teaches an x-ray tube including a body defining a vacuum envelope. A plurality of anode elements within the vacuum tube each defines a target face. The Morgan reference discloses anodes with opposing target faces. However, the Morgan reference also teaches each cathode assembly is disposed between adjacent target faces. A beam of electrons is focused on the pair of adjacent target faces.

This is significantly different from the present invention. The present invention does not share cathodes. The Morgan reference uses two targets and a single source. The two back-to-back anode target faces may increase the beam width in the Morgan reference, but the image will be distorted, and the quality of the image is compromised. To avoid image distortion and obtain a high quality image, the x-ray beam must be maintained as flat as possible. In Morgan, a true, flat, slice is not taken. The scan image will be flattened upon reconstruction of the image using an x-ray that isn't flat, and the image will appear distorted.

The present invention teaches and discloses cathodes for each of the anode target faces. The cathodes are not shared, and for good reason. Sharing cathodes will not work. The Morgan reference teaches away from

using a cathode for each anode face, in order to reduce the amount of heat generated during the scan. It is respectfully asserted that the present invention is patentable over the Morgan reference.

Because the Morgan reference specifically teaches away from using a cathode for each target, it cannot possibly teach or suggest the present invention, which teaches back-to-back anode target faces, each with a respective, or corresponding, cathode supply. It is respectfully asserted that one skilled in the art would not look to combine the references as suggested by the Examiner to accomplish the applicants' invention. Further, it is respectfully asserted that even if the references were combined as suggested by the Examiner, their combination would not result in the applicants' invention.

It is respectfully requested the Examiner withdraw the rejection of claim 1-22 under 35 U.S.C. § 103. Should the Examiner have any questions or comments, he is respectfully requested to contact the undersigned attorney.

Respectfully submitted,

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